Learning Math Facts - Fast!

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**Abstract**

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**Chapter One**

**Research Problem**

At the start of the school year it was observed by classroom teachers at Red Mill Elementary that there is a deficit in regards to fast fact recall. Teachers have come to these conclusions based upon informal classroom observation and beginning of the year benchmark tests. Students struggle to solve complicated multiplication and division problems quickly due to this fact deficit. Although teachers strive to close this achievement gap, there is not enough time to review the math efficiently. This is supported by Crawford (2004), who stated “Teachers are often required to move on to the next set of facts too soon” (p.43). This is due to pacing guides and the pressure of mandated testing schedules. During this research project a program would be researched that teachers could use, and students would enjoy in an attempt to increase student success with fast recall of multiplication facts.

The proposed project would include implementing the Rocket Math program in a classroom and comparing those results with another classroom not using Rocket Math. Rocket Math is a program that some teachers use, but teachers have not been formally trained on how to implement the program.

**Significance**

By researching a certified program for quick recall of math facts, a researcher would, most importantly, find a working method to increase student achievement, without taking up a large portion of instructional time. When students have more than five minutes per day to practice facts, their overall success in math facts is increased (Casey, 2003). If this program is successful it could not only benefit students in Red Mill, but students throughout the district.

**Research Question**

1. Does the Rocket Math program increase overall student achievement in multiplication and division facts?

**Definitions of Terms**

Rocket Math - “Rocket Math is a ten-minutes-a-day, paper and pencil, worksheet-based, supplemental, math facts practice curriculum. It is a uniquely structured curriculum for the sequential practice and mastery of math facts.  Students learn 2 facts and their reverses on each worksheet in a carefully controlled sequence which enables mastery at an individualized pace.  Students practice orally with a partner every day.  One minute timings assess when students are ready to move to the next set of facts” (Crawford, 2011, p.1).

Fact Automaticity - Automatic recall of facts without conscious control (Hasselbring, Goin & Bransford, 1988).

**Chapter 2**

**Political Context**

Due to the demands of legislation, such as No Child Left Behind (2001), teachers are required to have their students perform well on state mandated tests. Math facts play into this equation because knowing math facts sets a solid foundation for other mathematical concepts. Multiplication and division are explicitly tested on the Pennsylvania State Standardized Assessment, and the first math anchor, Numbers and Operations, requires that students apply fact knowledge to solve problems (Pennsylvania Department of Education, 2004).

The National Council of Mathematics also places emphasis on the importance of fact memorization. The Council recommends that all fourth grade students develop fast recall of math facts in their Focal Points (2000). Daily fact practice must be implemented for this goal to be achieved (National Council of Mathematics, 2000).

**Theoretical Framework**

To build some background on how students assimilate math facts, it is important to first review two ways which children learn. Understanding how a child’s brain functions when learning math facts and maintaining facts supports this study.

**Cognitive Development**

Perhaps the most famous name in researching child development is Piaget. In the early 1900’s Piaget identified stages of development that children pass through as they become more complex thinkers. The stage one would focus on in terms of learning math facts is the concrete operations stage. In this stage of math development, children “acquire experiences that help lay the foundation for more advanced mathematical thinking” (Ojose, 2008, p. 28). This is the stage in which the learning and memorization of math facts is critical to a student’s success in subsequent years of school. In a study, the researcher Ojose (2008), found that one key element of these experiences is to allow students to make connections between mathematical ideas. Therefore, allowing students to practice inverse operations repeatedly strengthens these connections. Repeated fact practice of multiplication and the inverse, division, are important experiences for children to have according to Piaget’s framework.

**Working Memory and Memory Retrieval**

The working memory is defined as “a system devoted to short-term storage and processing” (Imbo & Vandierendonck, 2007, p. 1759). The working memory is important to fast fact recall because humans access the working memory to access short term knowledge. The relevance of this information is that students must be taught their facts so that fact knowledge moves past working memory and is stored in the long-term memory. Imbo (2007) states, “ the acquisition of multiplication and division skills and strategies is based on the memorization of problem-answer pairs” (p. 1760). This repeated practice of problem-answer pairs moves the knowledge to the long-term memory. If repeated practice does not occur, the math facts stay in the working memory, where they continue to be only accessed for the short-term and not deeply learned. The best way to memorize facts and transfer knowledge from the short-term memory to the long-term memory is supported by Crawford (2004), “In order to learn to rely only on their memory, [as opposed to counting on fingers or skip counting] students must practice and master facts in very small chunks or sets of facts - like two facts and their reverses or a set of three facts in a row” (p.43).

**Effective Teaching Strategies to Promote Automaticity**

With numerous math programs and new initiatives that are available, it can be confusing to decide on what route an educator should take when reviewing or teaching math facts to children. The following summarizes current research to guide educators in making their decision on the best route.

The struggle about fact memorization is to scaffold children away from using strategies such as finger counting to using the strategy of recalling. Once students can “recall” facts rather than derive them, such as, counting on fingers, they will develop fact fluency. According to Hasselbring and Goin (1988) the use of “remembering” is the successful movement of knowledge from the short to long term memory.

Students must learn new math facts in small sets of information. This chunking of material is supported by Graham (1987). Graham recommended that math facts be grouped together. He stresses the importance of separating easily confused facts. For instance, 7 x 6 = 42 should not be in the same set as 8 x 6 = 48 due to the similar nature. Graham’s study also suggests teaching more difficult facts from the start of a program so a student has more opportunity to practice and learn them. Generally, the most difficult fact families are the 6’s, 7’s and 8’s (Graham, 1987).

With repeated, daily practice of small fact sets, “automaticity can be attained very quickly if there is not much to be learned. Even if there is much to be learned, parts of it can be automatized quickly if they are trained in isolation” (Logan and Klapp, 1991, p.193). With repeated practice, students will master this small set of facts, then be promoted to another small set of facts. Along with new facts, challenging facts are continually practiced. Drilling the facts will allow students to free up their working memory because they will no longer rely on that method of memory retrieval (Goldman & Pellegrino, 1986).

One effective strategy to achieve memorization of math facts is to provide the answers so that students do not have to “recall” the answer. Recalling the answer by using old strategies of finger counting would be progress in the opposite direction. Hasselbring (1998) states in his research that the “use of controlled response times may be the most critical step to developing automatization. It [timing the response time] forces the student to abandon the use of counting strategies and to retrieve answers rapidly” from the long-term memory (p. 4). A suggested strategy to give a student answers is to have facts and answers at the top of a practice worksheet. Another strategy is to have students work in pairs where one partner completes a math practice sheet while the other partner gives the answer when partner one does not know the answer quickly (Hasselbring, 1998).

Rocket Math is an established program which combines this research into action. This program uses worksheets to practice and learn old and new facts. Facts are presented in small sets with their inverses. These worksheets in the program are easy for the teacher to use. “Each worksheet can introduce the new set of facts as well as be used as a mastery test to determine when the student is ready to begin memorizing more facts” (Crawford, 2004, p. 44). The worksheets also allow for differentiation; when a student is ready to move on, they do.

After the students complete a practice portion, they also do a 1-minute timed test. The recommended pass rate is a minimum of 40 correct per minute (Crawford, 2004: Howell & Nolet, 2000). Rocket Math is well liked by students in part because students feel successful. The small sets of facts and the gradual introduction of new facts allow students to “see success in small increments” (Crawford, 2004, p. 45). Students also “remain motivated and encouraged” to continue on with their practice sessions at school and home (Crawford, 2004, p. ?). Eventually, through daily use and practice the long-term goal is achieved, states Crawford (2004), “students can answer any math fact instantly and without having to stop and think about it” (p. 43).

**Chapter 3**

**Purpose**

The purpose of the proposed study is to evaluate the Rocket Math Program. A researcher in the proposed study would determine if the program helps increase automaticity of fast facts in multiplication and division facts in fifth graders.

**Study Design**

This study will use an experimental pretest-posttest design and collect quantitative data.

**Procedures**

Each classroom in the proposed study will be given the same pretest. The test will be composed of a variety of 80 multiplication and division facts. 80 is the number of facts utilized in the pretest because in Rocket Math 80 is the number of facts assessed during a two minute timed test. Students will have two minutes to complete as much (what does much mean?) as they can. The same test will be used as the post-test at the end of the study. The student success rates will be calculated and averaged together. (you may need to explain this further) The pretest will occur on the first school day of January.

Every day throughout the month to January, February, and March the experimental classroom will be learning how to use Rocket Math and implement the program in their practices. Student progress will be monitored and student success will be celebrated.

In the control classroom, students will also be given two midpoint assessments using the same test as the experimental group classroom. These midpoint assessments will serve as a measurement tool for the researcher to determine if growth is being made steadily when comparing the experimental and control groups.

**Setting and Sample**

The setting will be two fifth grade classrooms in the West Shore School District. One classroom will be a grade-level math class that does not use Rocket Math. Another classroom will be a grade-level math class that will be implementing Rocket Math. It is necessary to use two different elementary schools due to the fact that math classes are leveled in the beginning of the year by ability.

**Instruments**

Data will be measured using a two minute timed test that is inspired by the tests within Rocket Math.

**Data Collection**

Data will be collected at the beginning and end of the study to see the results of student progression. Data will also be collected at two midpoints. The purpose of this will be to see if progress is being made by students during the study.

**Data Analysis**

At the end of the study, the data from each classroom will be compared. An analysis will be used to determine if there is a significant difference between the control group and the experimental group based on the difference between the pretest and posttest scores.

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